



Raspberry Pi and SDR

Experiments and
Possibilities

Feb 2016 Talk

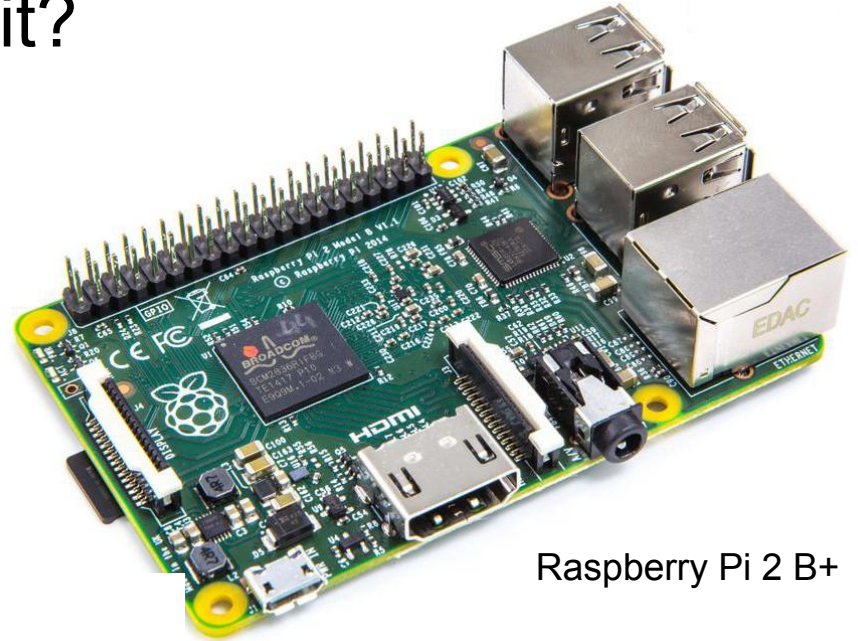
by Ty, VK6HTY



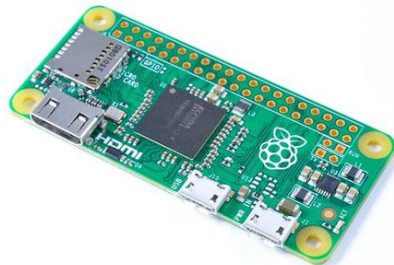
Good enough to eat

The Raspberry Pi, What is it?

- A credit card size computer
- Educational and experimental tool
- Models (bit like old Fords)
 - Rpi v1 Model A, A+, no ethernet
 - Rpi v1 Model B, B+
 - Rpi v2 Model B
 - Pi Zero
- Specs for Rpi 2 B+
 - ARMv7 Quad-core 900MHz, 1Gb RAM
 - Power 5V, ~0.3A, ~3W
 - HDMI 1080p
 - Audio In/Out 3.5mm
 - 4 Usb's
 - 40 Digital GPIO's



Raspberry Pi 2 B+



Pi Zero

What runs on it?

- Raspian - based on Debian Linux - Wheezy or Jessie - ~1Gb images
- Ubuntu Snappy - development base, headless
- Windoz 10 IOT Core
- Custom images:
 - GNU Radio on Rpi <http://garethhayes.net/gnu-radio-for-raspberry-pi/>
- Links: <https://www.raspberrypi.org/downloads/>



Things to make Rpi go

- USB micro cable + USB power adapter, 5v 2Amp
- SD card - Micro for Rpi 2, std size for Rpi 1, bare min 4Gb, std 8Gb, class 10
- Powered USB Hub ??
- Case
- HDMI cable
- Display
 - Touch screen 2.5...7in
 - Any display with HDMI, 1080p



- Head sinks - CPU and video chip
- Wifi - Mini USB dongles
- Keyboard + mouse or Remote in with ssh
- Add-ons -
 - Sleepy Pi - adds a shutdown button <http://spellfoundry.com/products/sleepy-pi/>
 - POE Pi

Where to get them?

- Altronics and Jaycar carry them if needed right now, but a little pricey.
- RS Components:
 - Rpi ModelB+ ~\$31
 - Rpi 2 ModelB+ ~\$43
- Ebay
- Element 14

GPIO Numbers

Raspberry Pi B
Rev 1 P1 GPIO Header

	Pin No.		
3.3V	1	2	5V
GPIO0	3	4	5V
GPIO1	5	6	GND
GPIO4	7	8	GPIO14
GND	9	10	GPIO15
GPIO17	11	12	GPIO18
GPIO21	13	14	GND
GPIO22	15	16	GPIO23
3.3V	17	18	GPIO24
GPIO10	19	20	GND
GPIO9	21	22	GPIO25
GPIO11	23	24	GPIO8
GND	25	26	GPIO7

Raspberry Pi A/B
Rev 2 P1 GPIO Header

	Pin No.		
3.3V	1	2	5V
GPIO2	3	4	5V
GPIO3	5	6	GND
GPIO4	7	8	GPIO14
GND	9	10	GPIO15
GPIO17	11	12	GPIO18
GPIO27	13	14	GND
GPIO22	15	16	GPIO23
3.3V	17	18	GPIO24
GPIO10	19	20	GND
GPIO9	21	22	GPIO25
GPIO11	23	24	GPIO8
GND	25	26	GPIO7

Raspberry Pi B+
B+ J8 GPIO Header

	Pin No.		
3.3V	1	2	5V
GPIO2	3	4	5V
GPIO3	5	6	GND
GPIO4	7	8	GPIO14
GND	9	10	GPIO15
GPIO17	11	12	GPIO18
GPIO27	13	14	GND
GPIO22	15	16	GPIO23
3.3V	17	18	GPIO24
GPIO10	19	20	GND
GPIO9	21	22	GPIO25
GPIO11	23	24	GPIO8
GND	25	26	GPIO7
DNC	27	28	DNC
GPIO5	29	30	GND
GPIO6	31	32	GPIO12
GPIO13	33	34	GND
GPIO19	35	36	GPIO16
GPIO26	37	38	GPIO20
GND	39	40	GPIO21

Key

Power +	UART
GND	SPI
PC	GPIO

Software Defined Radio (SDR)

Specs:

- 8-bit ADC
- Tuner R820T/R820T2 or E4000
- Range ~22MHz - 1700MHz
- Bandwidth 3.2 MHz
- Input impedance is 75 Ohms
- Current: ~300mA
- DVB-T RTL2832U
- RT-SDR drivers/modules
- Connectors, PAL or MCX -> pig-tail mcx to SO-239

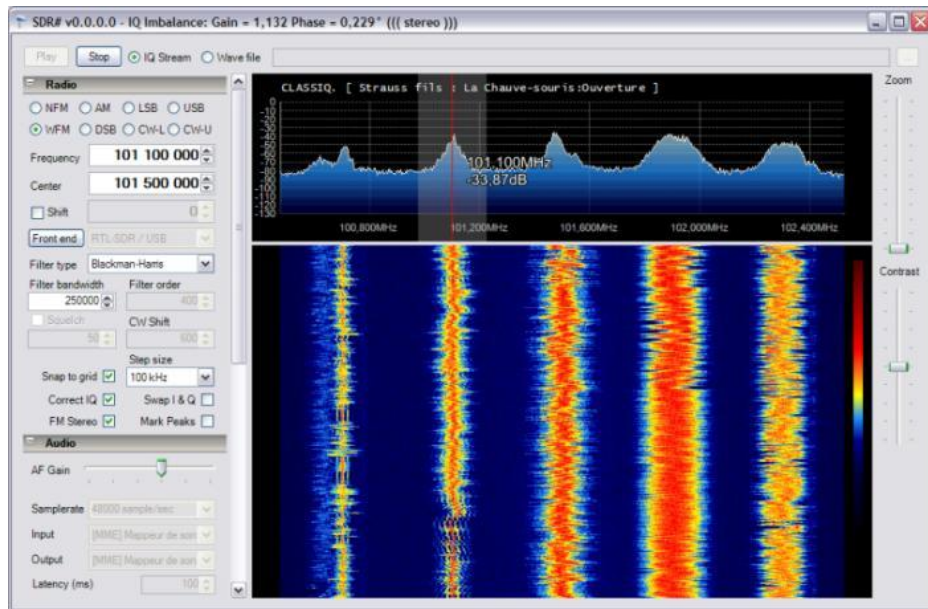


Funcube, SoftRock, HackRF/BladeRF,



Software Defined Radio (SDR)

- Calibration
- Filtering - bandpass, bandstop
- Interference:
 - 28.8MHz crystal creates drift
 - Spurs at 48MHz from USB
- Converters:
 - Ham-it-up HF converter
- Software:
 - Win32 - SDR# , HDSDR, SDR-Radio
 - Linux GQRX, Xastir



Uses for SDR + Rpi in Amateur Radio

- APRS
 - aprsd
 - direwolf 1.2 - <https://github.com/wb2osz/direwolf>
 - <http://aprs.fi/#!addr=perth>
- Frequency scanner
 - Freq Show
- WSPR
 - PITX QRP TX shield for WSPR on 20m
 - https://www.tapr.org/kits_20M-wspr-pi.html
- RxTx
 - PiFM - <https://github.com/rm-hull/pifm>
 - RpiTx - <https://github.com/F5OEO/rpitx>
- Rpi Oscilloscope
 - BitScope - <http://www.bitscope.com/pi/>
- Links: <http://www.rtl-sdr.com/tag/raspberry-pi/>

Custom Build SDR's

RFSpace

<http://rfspace.com/RFSPACE/Home.html>



HackRF

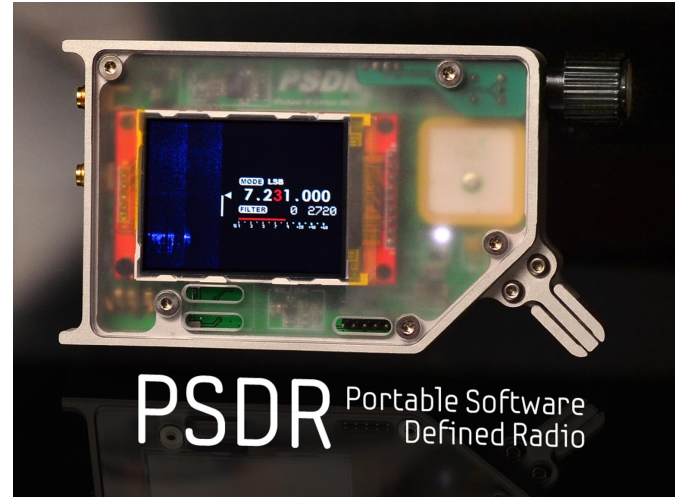
<http://greatscottgadgets.com/sdr/>



PSDR

<https://www.kickstarter.com/projects/1703258614/psdr-pocket-hf-sdr-transceiver-with-vna-and-gps/description>

All mode, 0 - 30MHz QRP transceiver

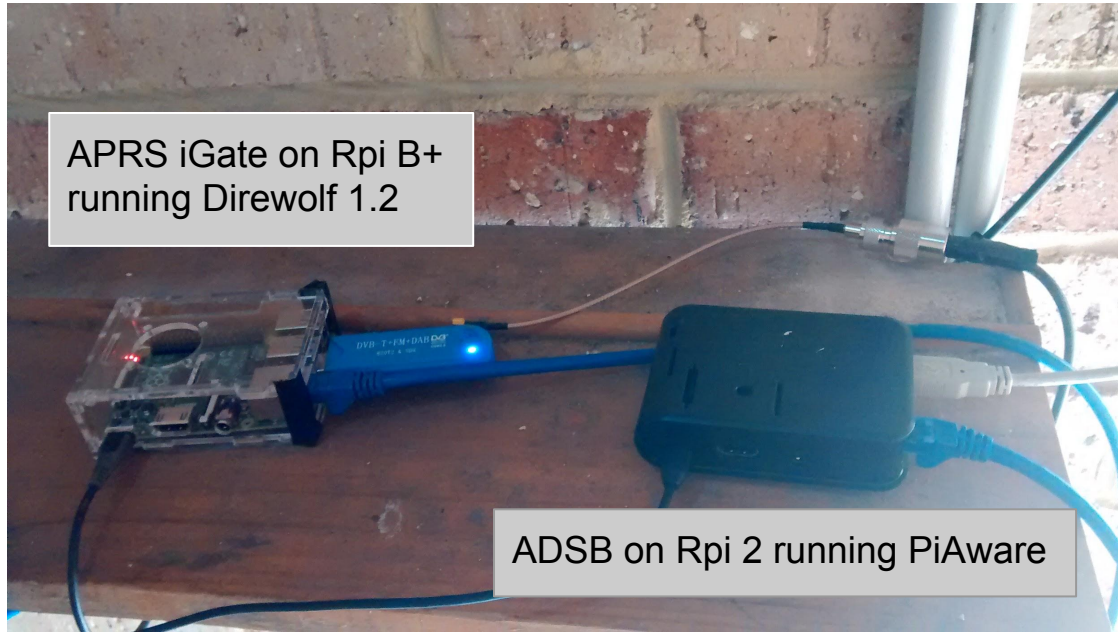


Rpi + SDR Possibilities for Amateur Radio

- Ku-band LNB + Bias Tee + SDR = Rx 10 GHz
- Rotator Controller - OpenCV, python
- Remote Control on HF/VHF station - VPN/Remote Desktop over network/internet ???
- Desktop for a Log Tracker
- Weather Station - sensors, temp/hum, barometric pressure
- Janielectronics - Microwave VCO: 8.5 - 10.8 GHz http://janielelectronics.com/product/product&product_id=108 <https://www.youtube.com/watch?v=MSk2mY6>
- ADSB - 1090 MHz
 - PiAware - <http://flightaware.com/adsb/piaware/build>
- Android SDR



My Experiments



Security Camera, RPi-Cam - <http://elinux.org/RPi-Cam-Web-Interface> with NOIR camera, motionEyeOS - <https://github.com/ccrisan/motioneyeos>

Seti@home
Einstein@home

Wifi Network Router

PiPhone

Music Manager/Player
RuneAudio <http://www.runeaudio.com/>

Media Centre
Kodi, Openelec

Web Kiosk/Displays - Screenly -
<https://www.screenlyapp.com/ose/>

Uses for Rpi

Astro PI
Pi on the ISS

Home Automation

Book Scanner

Cloud Server

Radio Astronomy:
Mario Cannistrà
<https://www.hackster.io/mariocannistra/radio-astronomy-with-rtl-sdr-raspberrypi-and-amazon-aws-iot-45b617>

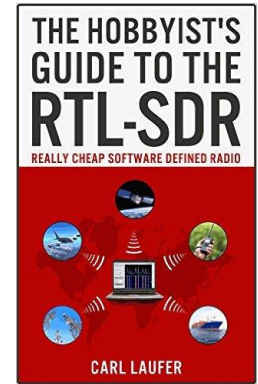
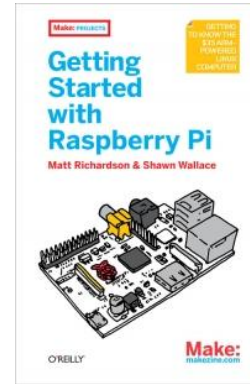
Heart Rate Monitor:
<http://johannesbader.ch/2014/06/track-your-heart-rate-on-raspberry-pi-with-ant/>

Soft PBX,
FreePBX,
asterisk

Night-View Goggles

References and Books

- The Hobbyist's Guide to the RTL-SDR: Really Cheap Software Defined Radio by Carl Laufer
- <http://www.rtl-sdr.com/>
- <http://www.rtl-sdr.com/buy-rtl-sdr-dvb-t-dongles/>
- <https://www.raspberrypi.org>
- Getting Started with Raspberry Pi
- Indepth article on SDR <http://www.arrl.org/files/file/Technology/tis/info/pdf/020708qex013.pdf>
- KB1OIQ - Andy's Ham Radio Linux - <https://sourceforge.net/projects/kb1oiq-andysham/>



Multicopter Super Drone <https://www.youtube.com/watch?v=t5JgnMJzCtQ>

